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Cost and benefit of Internet-based support of business processes

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Abstract

Even though the new economy hype is gone, the Internet is still an attractive communication infrastructure. It allows to set up specific information flows between various users, customised in functionality and the required level of interactivity. Using the Internet, even smaller companies can take advantage from electronic data interchange, and achieve cost reduction or an improved information quality. To access these potentials, investments in IT, organisation and training are required. However, the problem for a company is first, to decide which processes should be supported by a web-based solution, and second, when the solution as such is designed, to estimate its consequences on the processes, the possible benefit and the necessary investment. Our hypothesis is that processes, their communication and the IT have characteristics which allow a rough evaluation whether an Internet support will be economically justified. Based on this, an estimation method is developed. It suggests a set of characteristics for a rough evaluation and a framework for a fine estimation for cost and benefits with an integrated view on both organisational and technical solution.

Keywords: Electronic data interchange; Evaluating Internet usage; Characteristics of communication; Small and medium sized enterprises

1. The role of the Internet

1.1. Information and communication in production

The industrial production is typically characterised by a division of labour, which requires the co-ordination of various activities in order to produce goods and services. The quality of the co-ordination influences the quality and efficiency of the business processes, which determines the product features, like for example their delivery time, costs and quality (Eversheim, 1995; Frese, 1995; Wall, 2000). Co-ordination consists of information and communication, and it generates costs to provide them. Thus, different organisational structures, each with its own customised co-ordination mechanisms, generate different costs for co-ordination.

The co-ordination costs are part of the total process costs and have to be considered when redesigning processes and organisational structures. They determine whether certain organisational possibilities are economically justified and can be realised: "Any organisational solution, understood as a possibility to manage division of labour, starts at the rationalisation of information and communication" (Picot and Reichwald, 1994).

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The costs for information and communication can be considerably lowered by information technology (IT) (Frese, 1995; Picot and Reichwald, 1994). Thus, IT is broadly considered as enabler of organisational changes (Davenport, 1993; Grover et al., 1993).

Information and communication are also important for a company's external relationships, particularly the cross-company workflow. The globalisation lead to a massive market pressure with reduced profit margins, an increasing number of competitors and a reduced time-to-market (Stauffert, 1991). As a consequence, companies are forced to concentrate on their core competencies which in return increases the division of labour in a market. More and more, companies have to see their business processes in a wider context and as a part of a supply chain, in which many companies contribute complementarily to the final product (Hirschmann, 1998). In this light, the companies have to integrate any given business partner into effective information and communication: The company becomes an information "hub", providing information for all communication partners and process contributors, such as personnel, suppliers and customers (see Fig. 1).

The number of communication partners challenges the company's ability to provide a particular information in a compatible format. Therefore, the information integration requires

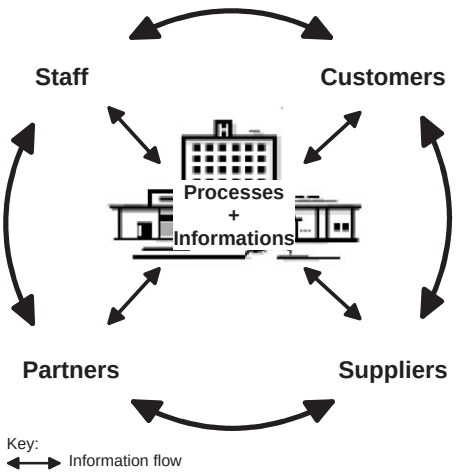

Fig. 1. Company as information "hub".
Source: Rost & Co. (2000).

communication channels and instruments which are flexible, common, and can be implemented quickly—at low costs. This is basically what the Internet offers as a communication infrastructure. The usage of the Internet seems to be an attractive option to support the business processes and improve their efficiency by enabling an information integration of external process contributors at an economically justified price.

The implementation of a new IT, however, requires investments, e.g. for the technical equipment, the organisational changes and education of the personnel. In return, benefits of an improved information quality and co-ordination have to be economically evaluated: While fulfilling specific information demands justifies the investment as such, the required investment capital is justified by the economic benefits which can be expected (Wildemann, 1985).

Small and medium sized enterprises (SMEs) in particular, with typically limited resources for investments, have to carefully choose the most suitable IT and information strategy for their processes: there is limited room for resource fixation in strategic investments, of which the operative payback is uncertain and in the far future, if it can be expected at all (Löser, 1999). Instead, costs and benefits of an Internet application that meets the assumed strategic importance and supports business processes have to be estimated early.

The experience shows, however, that the detailed economic analysis of specific organisational solutions generates some costs by itself which will only be accepted if improvements of the process performance can be reasonably expected. Therefore, a method should help to identify processes which promise high economic potential for an Internet-based support first. The method should further allow a systematic approach to estimate the economic effect of an intended process change, with an integrated view on both organisational and technical level and with as little costs as possible.

The existing methods for identifying operative weaknesses and economic potential can be roughly divided into two categories, those with a focus on process steps and operative goals and those

addressing the evaluation of information technologies. Methods with a focus on organisation are for example Business Process Reengineering by Hammer/Champy, Promet by the University of St. Gallen, Value Analysis or Activity Based Costing. They usually do not specifically emphasise the communication and the particular possibilities of the Internet, but rather focus on the process and its organisation, with little or no consideration for specific technical possibilities and challenges.

Evaluation methods for investments in IT, on the other hand, typically set in when the required technical solution is already designed. The focus lies on identifying the costs and benefits generated by specific technical options. As a consequence, the organisational effects caused by a new IT are easily neglected.

Therefore, a method is developed which supports the evaluation of interned based organisational solutions, which takes both organisational and technological changes into account.

1.2. Usage of the Internet in Swiss small and medium sized companies (SME)

Switzerland is a small country in western Europe with a population of around 7 Mio. people. The structure of the industrial companies is dominated by small and medium sized companies: The latest statistical survey counted a total of about 75,000 industrial companies of which the small (less than 50 employees) and medium (50–249 employees) sized companies have a share of 99.5% (see Fig. 2). Among the service companies, the picture is almost the same, as 99.8% of the companies can be characterised as SME (Bundesamt für Statistik: Statistisches Jahrbuch der Schweiz, 2001).

In August 2002, 87% of the Swiss companies used the Internet or planned to use it in the near future (Zaugg, 2002). Such figures can be found often, yet they do not reveal what "using the Internet" is actually referring to—simple e-mail or more complex applications. An idea is given by the operating costs for the companies, as shown in Fig. 3.

Fig. 3 indicates that the results of a survey in 2001 are still valid. In the area of after sales

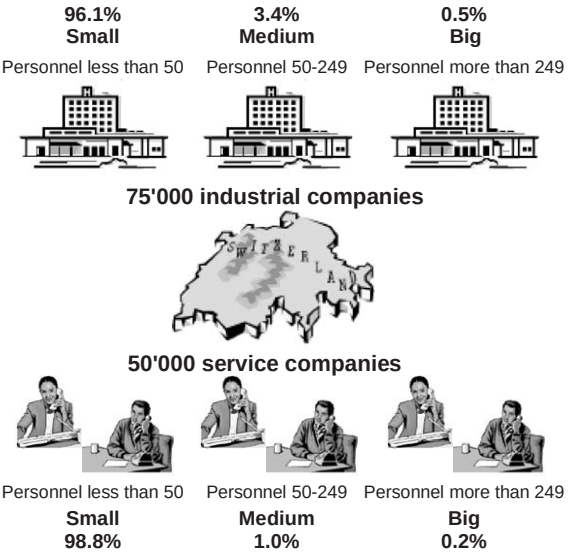

Fig. 2. Structure in industrial enterprises in Switzerland (Bundesamt für Statistik: Statistisches Jahrbuch der Schweiz, 2001).

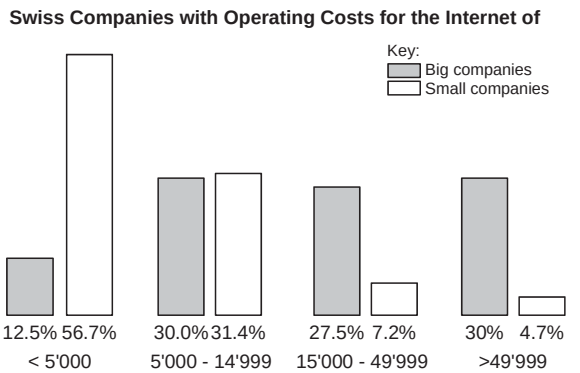

Fig. 3. Operating costs of the Internet in Swiss companies (data by Zaugg, 2002).

service, an increasing need for a more intense communication between suppliers and customers, as well as a growing importance of the Internet in the area of services was found (Hieber, 2000; Burger et al., 2001).

- The availability of information for short- and middle-term planning as well as an intensified integration of business partners in planning and control were evaluated as the main steps

in order to improve the cross-organisational co-operation and co-ordination.

- In the after sales, which was assigned a very high significance for success in future competition, the Internet was considered as one of the most important channels to offer various services. It was also considered as the upcoming main communication channel for information exchange, which is currently done via paper mail.
- The lack of compatibility between the various IT-systems used in the companies and high costs ranged on rank three and four of the top ten barriers for a more intensified communication between companies.

It is obvious that the problem mentioned above, to identify processes with high benefits and to evaluate the economic consequences with simultaneous view on both organisation and technical aspects, will be of importance in the next few years.

2. Characteristics as indicators for an economic potential

The suggested approach has two components, which have their starting points within the possibilities offered by the Internet as a communication tool with particular features (see Fig. 4). From there, a set of characteristics can be derived which indicate an economic potential by an Internet-based support for a process. On the other side, it is necessary to define operative goals, such as process cost, quality and time and necessary investments. The characteristics can be linked to the goals, thus indicating which goals will probably be affected by an Internet-based support.

If an economic potential is indicated, the business processes can be redesigned and the new processes, now with Internet-based support, can be evaluated according to the company's goals. If there is no potential indicated, the task and costs of a detailed estimation of benefit and investment can be avoided.

2.1. Characteristics of the Internet

The characteristics of the Internet, in comparison to common communication channels, e.g. fax, telephone, direct communication (face to face), postal service or specialised services for electronic data interchange can be summarised as follows:

- speed,
- consistency,
- immediate access,
- lowering transaction costs,
- flexibility, and
- extensibility.

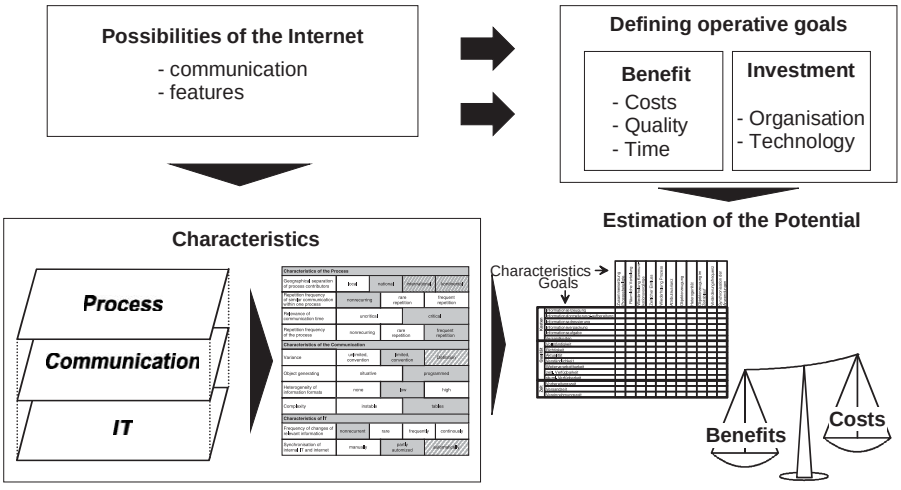

Fig. 4. Approach to an estimation method.

The speed in communication results from the light-speed with which electronic signals can be transferred. The consistency is given when two communication media exchange information in a compatible format. Since most information in companies is generated or stored electronically, an exchange of electronic data between two (or more) IT systems reduces redundant process steps like repeated data entry and errors due to that. The information exchange, however, is still typically carried out by paper-based fax or mail (Fehler, 1997).

Immediate access is given as the Internet is globally available, independent of time and place. The transaction costs, defined as costs for carrying out exchange transactions (Coase, 1992), can be lowered when the communication costs are lowered by using the Internet. The flexibility is given both to the content of the communication, the access, and its interactivity as well as to the communication partners: The broad distribution of the Internet allows the quick establishment of information links to communication partners.

The extensibility finally refers to the possibility of accessing further applications via a web-server, thus expanding the possible areas for Internet usage to nearly everything that can be controlled by a computer. This is the main advantage over existing and specialised data exchange infrastructures.

With its features, the Internet offers various possibilities to serve as a communication tool and support business processes mainly in the information flow. It can be used to either automate existing information flows entirely or partly, like for example supporting the ordering process by offering an online ordering procedure, or it can serve to establish new information flows, thereby enriching the already existing information flow in cross-company business processes.

2.2. Relevant analysing levels

With the Internet as a communication tool, the identification of an economic potential has to focus on the information flow of the business process and its contributors, both external and internal. Relevant analysing levels are the processes itself, their communication, and the IT currently in use in the company, given that most companies use some kind of IT, e.g. ERP-software, as main information source. The analysing levels are shown in Fig. 5.

2.2.1. Characteristics of the processes

On the process level, the characteristics serve as indicators for an economic potential, without considering whether an Internet-based support of

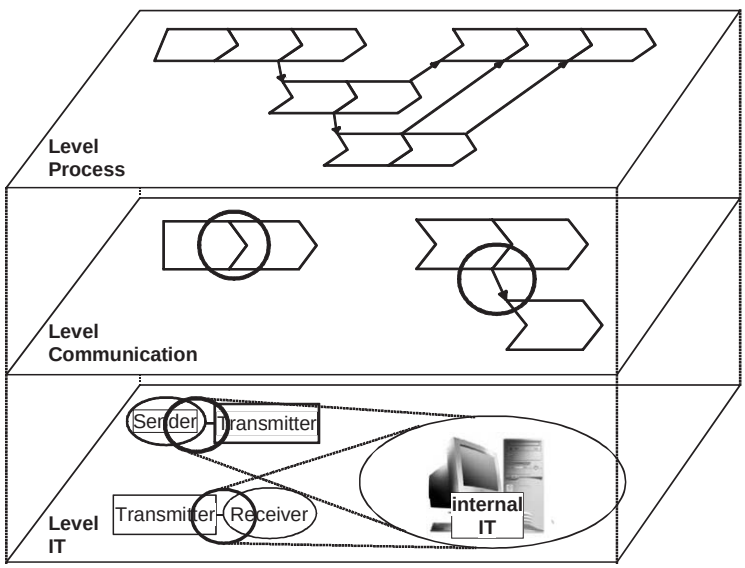

Fig. 5. Analysing levels for the identification of potential.

the information flow can be realised at all. Clues can be derived of the process elements, in particular the geographic separation of the process contributors, the repetition frequency of communications within one process, the relevance of the communication time, and the repetition frequency of the process repetition within a period. An overview of the characteristics is given in Fig. 6.

The geographic separation of the process contributors influences both duration and costs of an information transfer, because the Internet is faster and can be cheaper than postal services. While the duration of postal service with a national or local separation can be acceptable, an international or continental separation can reduce time and costs of the communication significantly. Additionally, the Internet allows a smoother information flow when the contributors are in different time zones.

The repetition frequency of similar communication within one process also influences communication costs and, depending on the specific communication, the duration of the communication. Frequent repetition of similar communication can occur for example when the same information is simultaneously given to several receivers, when information is repetitively exchanged, or when the relevant information changes often and a change initiates another communication. The Internet takes advantage of low marginal costs when reproducing electronic data, reduces the duration of the information transfer and enables immediate further processing of the information, or allows to direct relevant information changes to the recipient mainly concerned.

The repetition frequency of the process indicates a potential, because it shows how often an information source is accessed. Small savings per process can sum up due to the total number of processes and justify the investment.

The relevance of the communication time indicates to which extent the process time can be influenced: a critical relevance is given when a reduction of the communication time directly shortens the process time. This indicates immediate potential by using the Internet as a communication tool. A short process time is a main goal on the operative level and its reduction is often joint by reduced costs.

2.2.2. *Characteristics of the communication*

The characteristics of the process do not allow a judgement on whether or not a communication can be carried out via the Internet at all. This question is addressed with the characteristics of the communication. A communication basically consists of an information source, an information drain, a sender, a receiver, a transmission channel and the information. These elements can be of various types (see Fig. 7) with different skills and abilities to process a given information, and do not allow an immediate judgement of the potential of the Internet: rather, an information transfer can be supported by the Internet, if the information can be formatted in a way which the receiver is able to understand.

Interactions in which information source or drain or both are machines are of particular interest when integrating various information systems or automating data flow. Therefore, the

Characteristics of the Process				
Geographic separation of process contributors	local	national	international	continental
Repetition frequency of similar communication within one process	nonrecurring	rare repetition	frequent repetition	
Repetition frequency of the process	nonrecurring	rare repetition	frequent repetition	
Relevance of communication time	uncritical	critical		

Fig. 6. Characteristics of the process.

Element	Types					
Information source/drain	Person	Paper	mobile Data Store	immobile Data Store		
Sender/Receiver	Person	Person & Machine	Machine			
Channel	face-to-face	Phone	Fax	Postal Service	LAN	Internet
Information	Knowledge	Text/Picture/ Graphic	Unstructured Data	Structured Data		

Fig. 7. Various types of the communication elements.

Characteristics of the Communication			
Attribute Variance	unlimited, convention	limited, convention	Definition
Object generating	situative	programmed	
Heterogeneity of information formats	none	low	high
Complexity	unstable	stable	

Fig. 8. Characteristics of the communication.

analysis concentrates on the information and its characteristics, especially whether it can be structured, processed by computers and its complexity. The characteristics which indicate potential for an automated generation or processing of information are shown in Fig. 8.

An information object consists of a number of attributes which describe a specific issue. The variations of these attributes indicate whether the information object can be processed by a machine or has to be processed by a human being: defined attributes allow an automated processing because the computer can identify and interpret each attribute clearly. Information objects can also be processed automatically if the variations of notation and possible values are limited. In this case, the computer has to translate the incoming or outgoing information into the required notation. An unlimited number of attributes which are commonly understood, however, is typical for complex descriptions or information objects, like for example text documents or pictures. Information objects of this kind cannot be processed automatically and have to be interpreted by human beings.

Generating information objects can be based on a specific situation and differ significantly in each case, or can be programmed and follow a certain procedure. In the latter case, it can be generated by a computer or, for example within an ordering process, be supported by it. Such information objects can typically be displayed as a form.

The heterogeneity describes the required flexibility of sender or receiver to provide or interpret different information formats. If, for example, the information source is an ERP-software, some common information formats are already covered, like those of SAP, ORACLE, or EDIFACT, as most ERP-software provides proper interfaces. With one or two uncovered information formats, special adapters can be used, with one specific adapter for each communicating information systems. The Internet offers potential with an increasing number of unknown formats: The extensible mark-up language XML allows to use structured documents, which contain both the information and their meta-structure. By using XML, a communication partner needs basically one interface to generate XML documents and the knowledge about the meta-structures his communication

partner uses. For the future it can be expected that the data conversion into XML format is supported by features of the internally used software: currently, most ERP-software products on the market offer an interface to support the conversion of data into an XML format. The suppliers of office software also started to offer this feature (Gronau, 2001; Brors et al., 2001).

The complexity of the information is important for the possibilities to realise a specific Internet application. First, the complexity of the functionality, the transactions and the information objects influence the initial costs when programming the Internet application. As long as the complexity is stable over a period of time, the requirements regarding maintenance and education might be high but justified by the benefits. But if the complexity is unstable and requires many changes of the application, the costs for maintaining and updating the applications increase significantly (Schierholt, 2000). Unstable complexity is given, for example, in the assurance branch, as the law changes often and demands an update of procedures and products according to it.

2.2.3. Characteristics of the IT

The characteristics of the IT describe, with which frequency the relevant information changes and whether the synchronisation between the internal IT and the Internet application can be automatically performed. The characteristics are shown in Fig. 9.

If the relevant information changes rarely, the information transfer via fax or postal service might be a satisfying option if there are only a few receivers. If the information changes often or continuously, like for example tracking information or information about the order status, the Internet offers potential. Its speed allows to provide information which is up to date and personal requests can be avoided.

Since the direct access to internal systems via the Internet is out of question due to basic security considerations, information provided and received has to be transferred from the internal IT to the Internet application and vice versa. The synchronisation describes, whether this transfer can be processed automatically. Full automation indicates potential, if until now the information received or sent is manually entered or copied. A manual synchronisation, on the other hand, limits the potential indicated by the characteristics of process and communication, as it requires expensive personnel and increases the possibility of incorrect data entries. Most software products used in companies offer functions that allow the automatic generation and transfer of information.

2.3. Characteristic templates

To identify a potential for the use of the Internet, the existing communication or, in case that new information flows are planned, the designed information flow can be characterised by the suggested criteria. As a simple example, the Fig. 10 shows the characteristics of an order information of standard products chosen from a catalogue. Grey areas are the necessary characteristics which indicate an economic potential for an Internet-supported ordering. Hatched areas indicate an even higher potential.

For the estimation method, the characteristics of five typical Internet applications mentioned in the literature were analysed: information data base, file sharing, data entry, asynchronous data exchange and synchronous data exchange. The result of the analysis were five sets of characteristics that serve as templates when a specific communication is analysed. For details on their characteristics see Manecke (2002). Actual characteristics of a specific communication in question can be compared with the template of the

Characteristics of IT				
Frequency of changes of relevant information	nonrecurrent	rare	frequently	continuously
Synchronisation of internal IT and internet	manually	partly automated	automatically	

Fig. 9. Characteristics of the IT.

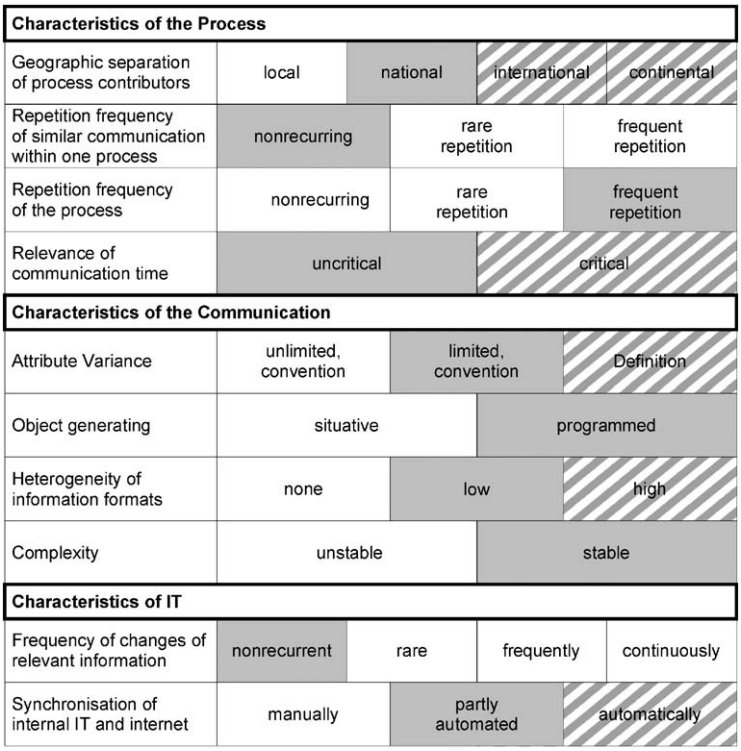

Fig. 10. Example for the characteristics of an order information.

matching application to see where a potential is probable or threatened.

3. Estimating a potential

In order to estimate the economic potential of an Internet-based process support, the first step is to measure or estimate the probable changes regarding the process performance. In a second step, the economic consequences of these changes are estimated. Consequences can occur internally, for example by saving costs, as well as externally, if performance improvements lead to market effects such as increased sales.

3.1. Estimating process effects

The evaluation of any process redesign has to be based on the company's goals, which on the operative level are typically costs, time and quality of the process or its outcome as well as flexibility in the processing. Potential, defined as possible benefits, is given when the performance regarding these goals can be improved.

From the various methods to identify and measure process costs and time, the method of process-oriented analysis by Eversheim (1995), which is similar to activity-based costing (ABC), has been chosen for the suggested method. He suggests to record the relevant process and its steps, according to the preferred level of particularisation. Then, the resource consumption generated by each identified process step as well as the required time to carry out the steps has to be identified and measured.

3.1.1. Costs

The resource consumption refers to a resource model (see Fig. 11), with the following resources: personnel, IT, equipment and material, rooms/buildings and capital.

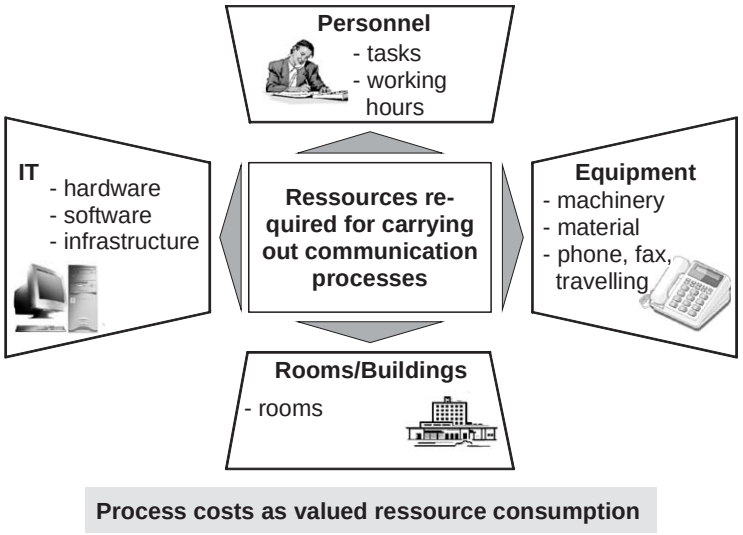

Fig. 11. Resource model for the evaluation.

To estimate the resource consumption, it's important to analyse which resources are consumed by each process step and then to calculate the consumed resources. To analyse whether a specific process step consumes a specific resource, a simple matrix table can be used, as shown in Fig. 12.

In Fig. 12, the resource consumption of the process step "create list of suppliers" is marked as conditional. The reason is that there are cases in which this process step will not be performed because the list of suppliers already exists. Conditional resource consumption is also given if a process step can be performed manually as well as automated.

Once the consumed resources are identified, the resource consumption can be calculated. This requires knowledge about the mathematical functions describing the consumption and the costs. The consumption function describes the resource consumption caused by the consumption driver. For each resource/process step combination, the consumption function is required. The cost function determines the generated costs according to the consumed resource units and resource quality (see Fig. 13).

A complete and exact measurement of the resource consumption would usually contradict the purpose of the estimation and probably generate vast costs. The estimation of the process costs can be simplified by limiting the calculation to those resources, which dominate the total costs. This will limit the number of functions. Information about consumption and cost figures can usually be provided by the accountant department. Other sources are working records, estimation based on experience or observation. The estimation has to be performed for the given and the future processes. The maximum potential for cost reduction is given by the total difference between the process costs "as is" and the estimated future process costs.

It is useful to stress out the difference between the process-oriented evaluation and ABC. ABC assumes one unique activity driver for each activity to trace the activity costs to the cost objects. This isn't always accurate. Often, the costs of a specific activity are determined by several activity drivers. The resource consumption for phone calls, for example, is determined by the number of phone calls and the durance of each phone call. ABC can consider several activity drivers only by defining several activities (Turney, 1992).

3.1.2. Time

Another process goal is the process time. The estimation of the process time requires the

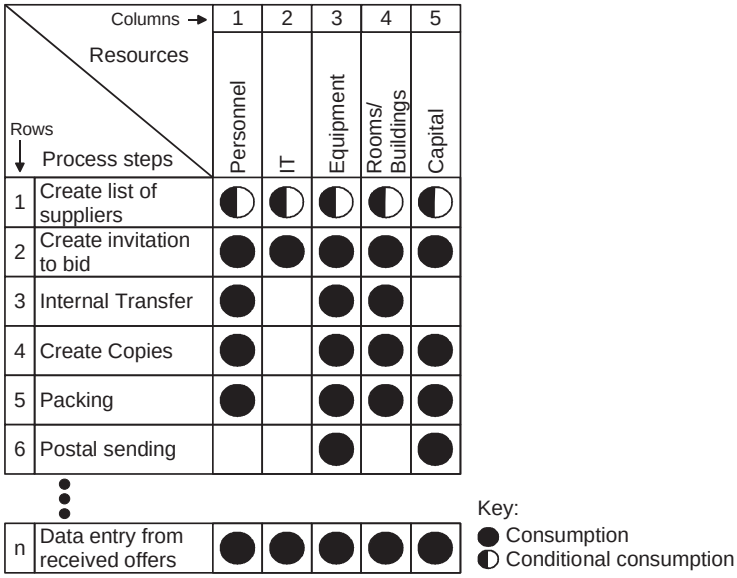

Fig. 12. Resource consumption by process steps.

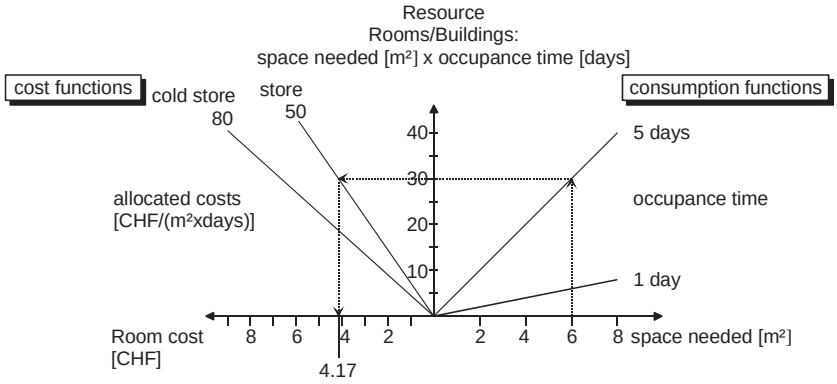

Fig. 13. Cost and consumption functions.

measurement or estimation of the duration of each process step, and an aggregation to the total process time. This has to be done for both current and planned process. The comparison of the process duration allows the calculation of the maximum potential in time reduction.

3.1.3. *Quality*

While cost and time improvements often can be deduced directly from the recorded process, changes in quality are not always visible. Partly, an improved quality is already implicated with the cost calculation: Less mistakes and errors caused by manual data entry, for example, lead to less personnel costs for correcting the wrong data or requests due to missing information, and might even reduce the average process duration.

The measurement of process quality is extremely complex, and cannot be reduced easily to a few key figures, as business processes are very specific and each company might have its own quality demands (Wilken, 1993; Picot and Reichwald, 1984). The

company will therefore have to apply its own quality criteria and measuring methods to the evaluation.

However, a general quality criteria mentioned in the literature is faultlessness (Eversheim, 1995; Wilken, 1993; Stauffert, 1991)—which for the purposes of this paper can be interpreted as faultlessness of the information used by the communication partners. This can be influenced by an improved information quality, which can be measured in attributes that characterise the information as (Zehnder, 1998; Mewes, 1972; Pfestorf, 1974; Picot and Reichwald, 1984):

- complete,
- accurate,
- up to date,
- understandable,
- processable, and
- available.

Any improvement of these attributes, according to the specific needs of a business process, can be considered a quality improvement. Key figures are, for example, the total number of requests due to unreadable or missing information, or the number of incorrect data entries.

3.1.4. Flexibility

Flexibility often connotes the ability to react fast on changing demands (Behrbohm, 1985), for example customers' demands regarding the product specification, the delivery time or the ordered quantity. Furthermore, disturbances in the order processing must be mastered (Knof, 1991). The flexibility is partly influenced by the business processes, but even more so by the capacity of the production facilities, the product design or the qualification of the staff (Behrbohm, 1985). The Internet cannot influence these.

Another influence factor on the flexibility is the extent of decentralising and the information management (Deuringer, 2000), which can be influenced by using the Internet. The availability of information is independent of place and time, and communication links can be established quickly. This advantage and contribution to the flexibility is achieved anyway by an Internet-based support of business processes, and does not require specific key figures. For other organisational improvements of flexibility, a company has to apply its specific measurements.

3.2. Estimating the economic effects

After estimating the performance effects for the future process, the effects have to be evaluated according to their economic consequences. The method suggests to consider economic consequences such as costs reduction, increased sales and opportunity costs.

Cost reduction can be caused internally or externally and they can be traced to improvements in costs, time and quality. Eliminating entire process steps, for example, will directly lower the resource consumption and costs. A reduced process time might lead to a reduced safety stock and thereby reduce costs. An improved information quality might reduce manual data entry or additional queries to clarify information. It is important to bear in mind that improvements of process time and information quality which effect the resource consumption can only be considered once: if they are captured with the resource model, they mustn't be evaluated additionally.

Cost reduction can also be an external effect, for example if improved information quality regarding the future demand for specific goods can be realised. Suppliers might use those figures for a better planning quality and lower their prices which saves costs for the company.

Increased sales can be achieved if the performance improvement can be passed onto the market. Reduced costs, for example, can lead to reduced prices and increased sales. Shortening the process time can lead to a reduced delivery time and help increase sales, too, by either allowing higher prices or increasing the number of sold products.

Evaluating the increased sales is more difficult than the cost reduction, because the expectations of other market players and their possible reactions have to be taken into account. Both elements are uncertain and difficult to predict. Information sources for possible effects on sales can be gained with market research.

Opportunity costs of an Internet-based support for business processes are the foregone return of

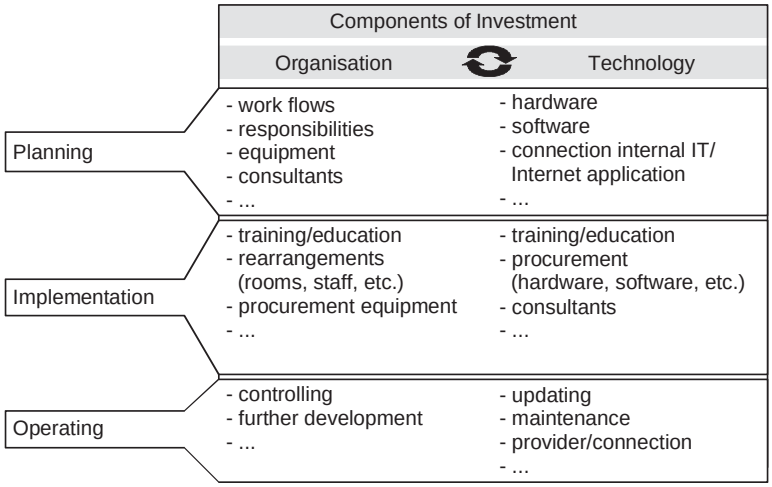

Fig. 14. Cost components of an investment in Internet application.

other alternatives for the required investment. The expectations of customers can well mean that instead of increased sales, the loss of sales and/or customers must is likely if the Internet-based support is not established. Furthermore, one or two of the process goals might deteriorate and either lead to negative market effects or to decreased profits if they are covered internally. The opportunity costs can be estimated, for example, by multiplying the possible loss of sales with the profit margin. Information about possible loss of sales or the "worth" of customers can be won by market research and from the management accounting.

The estimated economic effects can be added to the total potential, though it is advisable to keep the effects in separate classes, according to the estimated risks of the prognosis. This way, the decision risk is more transparent—if, for example, the prediction about the sales base on a poor probability yet dominate the decision, the decision bears exactly the failure risk of the prediction.

Since the estimations can contain errors, it is suggested to perform a sensitivity analysis and observe the effect of variations in the estimated parameters. After the benefit is estimated and the sensitivity analysis is done, it can be decided whether the changes of the operative performance as a whole can be expected to be satisfying.

3.3. Analysis of the necessary investment

The components of the investments are shown in Fig. 14.

Along these components, the required investment can be calculated. The investment generated by the organisational changes can be estimated based on prior experiences with reorganisation projects. The estimation for the technical equipment usually requires at least a rough specification of the demanded functionality, data traffic, bandwidth demand and security level. However, the investment for the technical realisation cannot be estimated based on prior experiences with IT projects, if these have not been Internet projects. Furthermore, many aspects, for example questions of security, or costs or manpower for programming, require expert knowledge.

It is suggested that the company requests estimations by suppliers of Internet applications according to the roughly designed technical demands, which gives a better understanding of the approximate investment. A sensitivity analyses of the investment components allows a greater transparency regarding errors in the estimation.

The comparison between the estimated benefits and the required investments then builds the basis for the company's decision to realise the Internet-based support for their business processes.

4. Case study

The presented case study was performed in the service department of a one-of-a-kind manufacturer in Switzerland. The focus was the order process for spare parts and additional machine parts, ordered by customers world wide. Fifty per cent of all orders are received directly from the customers, and 50% are received via sales organisations in several countries. Most orders are received by fax. The received orders are checked, corrected if incomplete or wrong (which requires queries via the sales organisation) and then forwarded to the production and distribution unit. Analysing the order process showed the following weaknesses:

- The entire information flow is by company rule designed to include the national sales organisation, which slows down the process.
- 20% of all incoming orders require queries due to missing, wrong or unreadable information.
- An estimated 30% of the order checks have no further purpose than to verify the—correct and complete—order information and could be automated.

The characteristics of the ordering process is shown in Fig. 15.

The analysis of the characteristics gave the following results:

- The repetition frequency of similar communication within one process is frequent, because the order interaction is repeated exactly by the sales organisations. Due to the company rule, this cannot be changed.
- The attribute variance is partly unlimited and convention: order via email often include a digital picture of the machine part in question. These pictures are no problem for an electronic solution.
- The frequency of changes of the relevant information is rare. Sometimes it turns out that the ordered part is actually not the desired part.

Characteristics of the Process				
Geographic separation of process contributors	local	national	international	continental
Repetition frequency of similar communication within one process	nonrecurring	rare repetition	frequent repetition	
Repetition frequency of the process	nonrecurring	rare repetition	frequent repetition	
Relevance of communication time	uncritical	critical		
Characteristics of the Communication				
Attribute Variance	unlimited, convention	limited, convention	Definition	
Object generating	situative	programmed		
Heterogeneity of information formats	none	low	high	
Complexity	unstable	stable		
Characteristics of IT				
Frequency of changes of relevant information	nonrecurrent	rare	frequently	continuously
Synchronisation of internal IT and internet	manually	partly automated	automatically	

Fig. 15. Characteristics of the order process in the service.

Such mistakes cannot be avoided with an Internet-supported process.
- The data entry into the ERP system has to be performed manually. The system currently used does not allow automated or partly automated data entry.

Dominant problems for an economic potential are the repetition frequency and the manual data entry. However, these problems might be compensated by the advantage of the continental geographic separation of the process contributors, and by the fact that the communication is critical for the process time. Therefore, the process was analysed in greater detail and the benefits were estimated.

A future process was designed, including an Internet-based application which allows electronic orders and supports an automated order checking to avoid wrong or missing information. It is biggest disadvantage was a change in the role of the sales organisations. So far, all the sales organisations had to do was to pass on the customer's fax. They rarely needed to create a new order, and they never had to check the order for missing or incorrect information. Only in case of a query due to the information quality, they had redundant communication first with the manufacturer and then with the customer. In the future, they would have to create electronic orders. On the other hand, their effort with queries due to incorrect or missing data would be reduced, as they could directly contact the customer and skip the redundant communication with the manufacturer.

4.1. Economic potential with given characteristics

Using the resource model, the manufacturer's process could be recorded and its performance was estimated. For the costs, a reduction of about 16% was possible. To estimate the consequences for the sales organisation, three different scenarios (best, probable and worst case) were considered, depending on the estimated labour costs and required time to create the electronic order. It turned out that the sales organisations could only achieve a cost reduction in the best case, due to low labour costs and short process time for the electronic order. In the probable case, their costs would rise by about 26%, in the worst case even by about 40%: even though the redundant communication was eliminated, the additional creation of electronic orders generated higher costs.

To realise the Internet-based process in the probable and worst case, the manufacturer would have to compensate the additional costs for the sales organisations. This was possible and left a small amount for necessary investments.

The improvement in information quality was not estimated separately, as it was already included with the process costs.

The improvement of the process time was significant only for orders with poor information quality. The future process could reduce the total process time for these orders by 1 day—but only if the order is received by fax. As a fax order is probably rare for urgent spare parts in case of a machine breakdown, it is more probable for additional machine parts, and might in those cases allow higher prices and therefore increased sales. Since no information about possible increased sales was available, the improvement of process time could not be evaluated.

To estimate the necessary investment, the technical solution was specified. It turned out that in the probable and worst case, the cost reduction after compensation did not allow an acceptable return on investment.

The Internet-based process, therefore, had to be based on the cost reduction alone, and could only be realised if the best case was true.

4.2. Economic potential with changed characteristics

In order to demonstrate the function of the characteristics, the estimation was also performed with the—theoretical—assumption that the ERP system would allow an automated data entry—the characteristic "Synchronisation of Internal IT and Internet" would therefore be "automatically". Additionally, the investment costs for this solution, including an adapter for automated data entry, was estimated anew.

	Best case	Probable Case	Worst Case
Cost Effect [%] - Sales Organisation -	-7%	+26%	+40%
Cost Effect [CHF] - Sales Organisation -	-4'000	+12'000	+18'000
Cost Effect [CHF] - Manufacturer -	-35'000	-35'000	-35'000
Theor. Potential for Manufacturer	**-39'000**	**-23'000**	**-17'000**

Best Case Labour cost -10%, creating order 5 minutes
Probable Case Labour cost -10%, creating order 10 minutes
Worst Case Labour cost equal, creating order 10 minutes

Fig. 16. Cost effects of the designed process.

The consequences for the process costs are shown in Fig. 16.

Under these circumstances, the manufacturer can not only compensate the additional costs for the sales organisations, but also realise the process change in the probable case and have an acceptable return on investment.

The worst case, however, did not allow an acceptable return on investment. To realise the process though, additional sales would be necessary. This means: if additional sales cannot be generated, the economic consequences of the Internet-based new process in the worst case are in total negative and the new process results all together in higher costs with improved process time and information quality. Though the probability of additional sales was unknown, the absolute additional sales needed could be calculated. With the absolute risk known, it is much easier to decide whether having an Internet-based ordering process is worth the risk of these costs.

5. Conclusion

The suggested model consists of two steps in order to estimate and evaluate a possible economic potential by Internet-based support for business processes. In the first step, the process, its communication and the IT are described by characteristics, which indicate a potential. These characteristics can be compared with templates of certain Internet applications, in order to determine a potential. Only if a potential can be reasonably assumed, the second step is performed, and the costs for a detailed analysis as necessary for an estimation of the potential are accepted.

The second step, a detailed estimation, is based on a process-oriented analysis that helps estimating the process performance for operative process goals. The method is simple and relies mostly on information, which is easily available or can easily be won, even in smaller companies. It can cover entire processes as well as important parts of the process only: the comparison between the process "as is" and the future process can therefore be limited to the process steps which are effected by the new information flow and redesign. The economic effects of a process change are analysed methodically and serve as base for a decision.

By focusing on the process, the method considers the organisational and technical effects in an integrated view, and the problem of separating the effects can be avoided. This is particularly useful if the Internet usage is embedded in a major process redesign when organisational changes are inseparably linked with IT changes.

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